

R e m a r k s

Amendments

No amendments have been made to the application.

Formal Drawing

A formal drawing (2 sheets) accompanies this response

Summary of the Invention

Before discussing the rejection on the merits, it will be helpful to briefly review Applicants' invention. In accordance with one aspect of the invention, as set forth in claim 1, a laser comprises: (1) an optical cavity resonator having first and second reflectors and an active region interposed between the reflectors; characterized in that (2) the second reflector comprises a resonant optical reflector (ROR) that *includes an optical gain medium*. The presence of the gain medium in the ROR means that the ROR is pumpable to reduce its loss (specification, page 2, line 17). In this fashion, in a laser that includes a single ROR, the laser output frequency is determined by the Bragg grating of the ROR only when the ROR is pumped (specification, page 4, lines 20-27). In a similar fashion, in a laser that includes multiple RORs, the laser output may have multiple frequencies determined by the Bragg gratings of only those RORs that are pumped (specification, pages 5, lines 9 *et seq.*).

Claim Rejections – 35 USC 102

Claims 1-9 and 11 have been rejected under 35 USC 102(b) as being unpatentable over T. Hirata, US Patent No. 5,145,792 (hereinafter *Hirata*). The Examiner states his position as follows:

With respect to claims 1-9 and 11, Hirata shows in Fig. 13e and 13f a tunable semiconductor laser comprising an optical cavity resonator having first and second reflectors and active region 21 interposed between the reflectors, a ***multiplicity of RORs***, a first waveguide that includes the active region, a second waveguide that includes the ROR ***gain media***, the second waveguide weakly coupled to the first waveguide, and means for pumping selected ones of the ROR ***gain media*** (col. 8, l. 32-50). (emphasis added)

This rejection is respectfully traversed for the reasons set forth below.

- (1) **Anticipation:** The law of anticipation under Section 102 is clear, as set forth in MPEP 2131: “A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Fros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). “The identical invention must be shown in as complete detail as is contained in the ...claim.” *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). In this case, Hirata fails to disclose an essential element of independent claims 1, 8 and 11; to wit, an ROR that includes an optical gain medium (claim 1, lines 5-6; claim 11, line 22) and a multiplicity of RORs each of which includes an optical gain medium (claim 8, lines 1-2). This feature of Applicants’ invention enables their laser to be tunable without the prior art instabilities (specification, page 1, lines 26 *et seq.*).
- (2) **Frequency Tuning in Hirata:** In contrast, Hirata describes two techniques for frequency (wavelength) tuning his laser, neither of which structurally or functionally corresponds to Applicants’ claimed invention. More specifically, Hirata describes a form of static tuning in which the bandgap of active region semiconductor material is altered by disordering a quantum well structure. In this fashion, the output optical frequency, which corresponds to the bandgap, can be tailored. In addition, Hirata suggests a form of dynamic tuning in the section cited by the Examiner (col. 8, lines 32-50; Figs. 13e and 13f). As described at col. 8, lines 44-65, the latter approach entails the use of a single ***conventional*** ROR of the type described by R. Kazarinov *et al.* in *IEEE J. Quantum Electr.*, Vol. QE-23, No. 9, pp. 1419-1425 (1987). This identical paper is cited by Applicants at page 3, lines 15-16 of their specification.

(For the record we note that the principal author of that paper, Dr. R. F. Kazarinov, is also a coinventor on the instant patent application.) Such conventional RORs include weakly coupled waveguides with a pair of separated DBR regions 24 on opposite sides of the coupling region 40, as shown by Hirata in Fig. 13f. The DBRs are tuned by means of electrode 12-5 (col. 8, line 50), which is incorrectly labeled 12-3 in Fig. 13e. The physics of the tuning mechanism is not described by Hirata. In absence of such a description, one skilled in the art would infer that the electrode 12-5 is used to supply electric current to the DBR regions 24, which in turn would alter the refractive index of the DBR gratings and hence their resonant frequency. Presumably therefore, the laser would be dynamically tuned by applying current to the DBRs (and hence to the ROR). However, this form of tuning is inherently unstable, as described by Applicants in their specification at page 1, lines 26 *et seq.* Clearly, therefore, Hirata does not recognize this problem, and, therefore, it is not surprising that he fails to describe Applicants solution to that problem.

- (3) **RORs Including Gain Media:** Applicants' solution to the problems raised by current instability in the prior art entails the use of an ROR that includes a pumpable gain medium, as described above and as required by independent claims 1, 8 and 11. Hirata is totally devoid of this feature. Nowhere in the entire Hirata patent, and in particular, no where in the portion of col. 8 cited by the Examiner, is there any mention of an ROR that includes a gain medium. In fact, in Fig. 13f cited by the Examiner the only gain region shown is the active region 21. The latter arguably corresponds to Applicants' active region set forth in claim 1, line 3, claim 8, line 31 and claim 11, line 21 [see also elements 18.2 (FIG. 1) or 118.2 (FIG. 3)], but in Applicants' claims the laser active region is separate from the ROR gain medium.
- (4) **Multiple RORs:** The Examiner asserts that Hirata discloses "multiple RORs," which are called for in claims 4 and 8-10. To the contrary, however, Hirata (Fig. 13f) describes a multiplicity of DBRs 24 (two in fact) that in combination form a part of only a *single* ROR.
- (5) **Additional Claim Features:** Dependent claims 2-7 and 9-10 are considered to be

patentable over Hirata not only by virtue of their dependence from independent claims 1 and 8, respectively, for the reasons described above and incorporated herein by reference, but also because these claims (as well as claims 8 and 11) include additional features that are not described by Hirata; to wit, (a) **Claims 2, 6, 8 and 11:** here an ROR reflects radiation back into the optical cavity in response to its gain medium being pumped. Hirata fails to disclose an ROR having a gain medium and hence likewise fails to described pumping such a gain medium; (b) **Claim 3:** here the ROR is characterized by having cavity losses that attenuate incident radiation in response to *not* being pumped. Again, Hirata fails to disclose an ROR having a gain medium and hence likewise fails to described *not* pumping such a gain medium; (c) **Claims 4 and 8:** here the laser includes a multiplicity of RORs each having a gain medium and each resonant at a different wavelength, but as above, Hirata describes no such gain media and no such multiple RORs; (d) **Claim 5:** here the gain medium is part of a monolithic structure. Although Hirata shows a monolithic structure, it does not include the requisite gain medium, as described above; (e) **Claims 7 and 8:** here the ROR gain medium is disposed in the second waveguide. Hirata is devoid of this feature; and (f) **Claim 9:** here the laser includes a multiplicity of segmented electrodes overlaying the second waveguide for applying voltage bias and pumping current to selected RORs. Again, Hirata fails to describe an ROR having a gain medium, fails to describe a multiplicity of such RORs, and hence likewise fails to describe pumping selected ones of such RORs in the manner claimed.

Accordingly, it is respectfully submitted that claims 1-9 and 11 are not anticipated by Hirata.

Claim Rejections – 35 USC 103

Claim 10 has been rejected under 35 USC 103(a) as being unpatentable over Hirata in view of Alferness *et al.*, US Patent No. 4,852,960 (hereinafter *Alferness*). The Examiner states, *inter alia*, that Hirata discloses “all of the limitations of the claim except for a transmitter and receiver,” which he relies on Alferness to describe. However, we note that claim 10 depends

from claim 8, and, therefore, for the reasons described above and incorporated herein by reference, Hirata does not contain the asserted disclosure.

Accordingly, it is respectfully submitted that claim 10 is not rendered obvious by the combination of Hirata and Alferness.

Conclusion

In view of the foregoing, reconsideration of claims 1-11, and passage of this application to issue, are hereby respectfully requested. If during the consideration of this paper, the Commissioner believes that resolution of the issues raised will be facilitated by further discussion, he is urged to contact the undersigned attorney at 610-691-7710 (voice) or 610-691-8434 (fax).

Respectfully,

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